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Attention	T.L.K.Smull, Director Grants and Research Contracts
Subject	Fourth Semiannual Report
Reporting Period	1 January - 30 June 1965
Grant Title	Study of Plasma Sheath Associated with Communication Blackout
Grant Number	NsG-472
Grant Monitor	Mr. Frank Russo, NASA Langley Research Center, Hampton, Va. 23365
Report Prepared by	Andrejs Olte Andrejs Olte, Associate Professor Electrical Engineering

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This is the fourth semiannual report on Grant NsG-472 and covers the period 1 January through 30 June 1965. In this grant we are concerned with some of the problems encountered in the plasma sheath blackout of communication on re-entry.

A paper "Radiation of an Elementary Cylinder Antenna Through a Slotted Enclosure," by A. Olte has been accepted for publication in the September 1965 issue of the Trans. IEEE, G-AP.

A paper "A Singular Integral Equation Approach to Electromagnetic Fields for Circular Boundaries with Slots," by Y. Hayashi has been submitted for publication to the NBS, J. of Research.

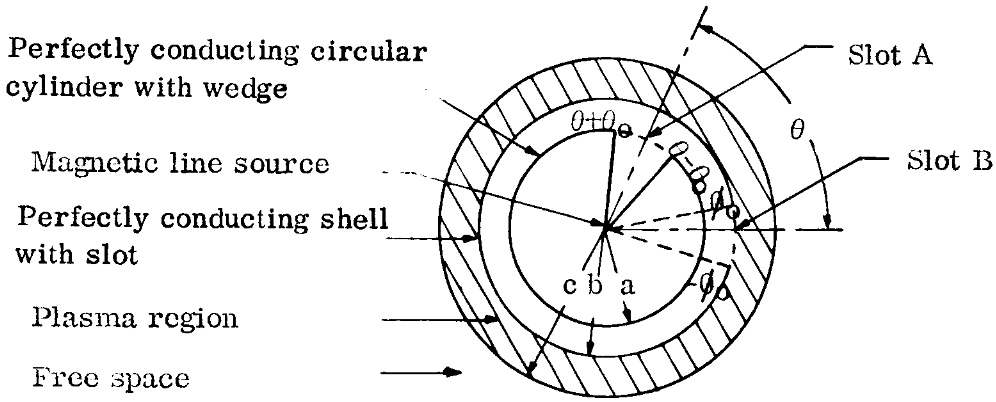
A paper "The Radiation Pattern of an Electric Line Current Surrounded by an Axially Slotted Plasma Sheath," by A. Olte has been accepted for presentation at the Third Symposium on the Plasma Sheath, 21-23 September 1965, Boston, Massachusetts. It will be published in the Proceedings of the Symposium.

The geometry of the first problem considered is shown in the Third Semiannual (5825-2-T). It involves a unit electric line source radiation through a slotted plasma sheath. The problem has been put in the form of a Fredholm integral equation of the second kind. This form is convenient when the electric currents penetrate the plasma sheath. A number of radiation patterns have been computed for conditions of practical interest and they will form the subject matter of the Plasma Sheath Symposium paper mentioned above. When the sheath electron density is such that the electron currents do not penetrate the sheath very deeply, then the integral equation approach tends to become laborious. We have recast the radiation problem utilizing waveguide concepts, because for a thick sheath the plasma slot becomes essentially a waveguide. We should be in a position to start computer programming in about a month on this new formulation.

The second problem that involves magnetic current line sources radiation through a slotted plasma sheath as presented in the last semiannual, has been formulated in terms of certain integral equations. Considerable work has to be done on this before some practical results will be obtained. We look forward to doing this towards the end of the next half-year.

In the third problem area we are concerned with a radiation problem of an antenna with cylindrical symmetry. The cross sectional view perpendicular to the axis of the antenna and its environments are shown below.

During the last period we regarded the wedge region as a transmission line and derived two expressions for the admittance looking at Slot A. One of these is stationary with respect to a small variation of the ϕ-directed electric field of Slot A (briefly, the field of Slot A). The other expression is not stationary, but it gives clear physical insight into the problem. To evaluate the values of admittance, a complete knowledge of the field of Slots A and B is necessary. For this reason we formulated two coupled integral equations for the slot fields. One of these is similar to the one we had treated last year. Upon using the previous results, the field of Slot B can be expressed in terms of the field of Slot A in a simple manner if $\phi_0 \ll 1$. Thus the crux of the remaining part of the problem is how to solve the other integral equation (i.e. how can we find the field of Slot B)? This work is already underway.



In the next period, we will obtain the field of Slot B for $\theta_0 \ll 1$. Then by using high speed computers the values of admittance will be calculated. From these results the effects of θ, k_0a, a/b, and $(k_1)c$ on the admittance where k_0 and k_1 are the wave number in free space and the plasma region, respectively, can be investigated.

AO/cfw